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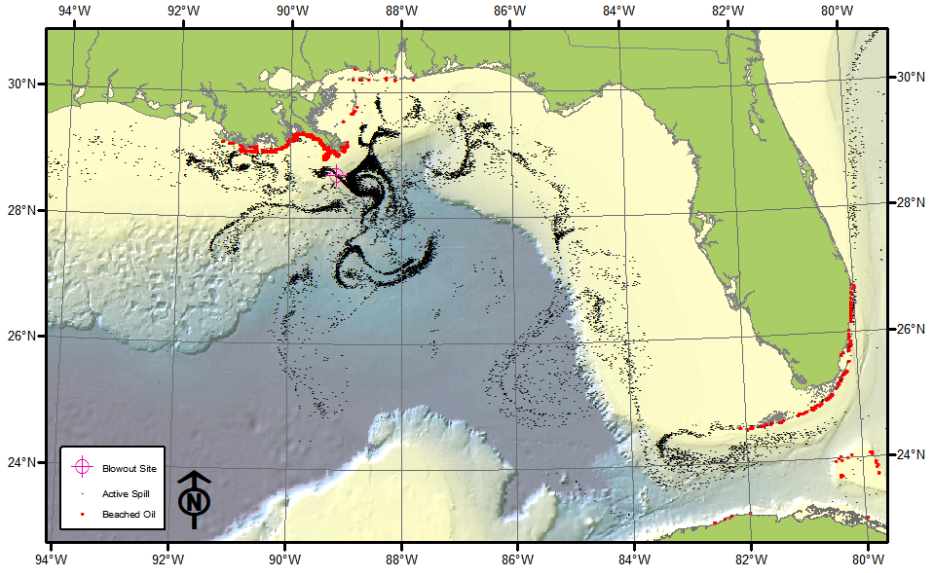
NETL's Blowout and Spill Occurrence Model (BLOSOM)

Background

The U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) has created an integrated data and modeling system to support DOE's mission to produce science-based evaluations of engineered and natural systems, to ensure sustainable, environmentally responsible access to domestic resources, and help prevent future hydrocarbon spills and impacts.

The Blowout and Spill Occurrence Model (BLOSOM) is an integrated system designed to simulate offshore oil spills resulting from deepwater (greater than 500 feet) and ultra-deepwater (greater than 5,000 feet) well blowouts. BLOSOM assists with risk assessment, can help to prevent future hydrocarbon spills, and serves as a comprehensive tool for response planning. BLOSOM is part of NETL's broader integrated risk assessment and spill prevention research effort, the Ultra-Deepwater (UDW) energy resources research portfolio. The UDW portfolio is focused on developing a scientific base for reducing and quantifying potential risks associated with exploration and production in extreme offshore environments.



The image shows the predicted spill trajectory 40 days after a hypothetical blowout. The image also shows the predicted location of beached oil as a result of this hypothetical spill.

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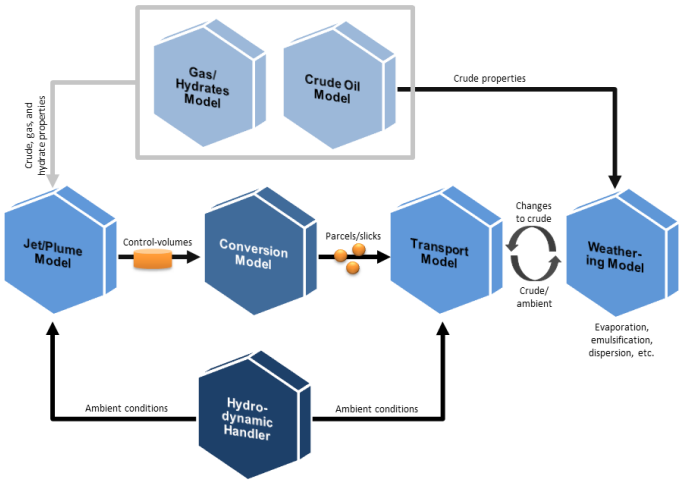
BLOSOM

Project Description

BLOSOM offers a flexible suite of modeling tools designed to work together as a single system, taking into account the multiple environmental uncertainties associated with deepwater and ultra-deepwater environments and blow-outs. All components are designed to be explicitly three-dimensional and use equations best suited for high-pressure environments while maintaining the flexibility to operate with limited or highly uncertain data.



Overview of BLOSOM modeling components

BLOSOM incorporates into one tool the capabilities of several models:

- The Jet/Plume Model simulates the initial oil and gas jet rising from the wellhead and tracks it until it reaches a terminal level. All crude oil, gases, and water are handled within a conceptual control volume that changes properties as it entrains ambient water.
- The Transport Model simulates the long-term fate and transport of the spill and monitors beaching and sinking events.
- The Conversion Model allows for the transfer of elements from the Jet/Plume and Transport models, taking care to best amalgamate the two contrasting approaches in each, while transferring control-volumes of mixed fluids into particles. This model also appropriately distributes oil droplet-sizes to best capture subsurface plume formation.
- The Weathering Model simulates oil weathering and degradation processes, including spreading, evaporation, emulsification, and dispersion. Other processes, such as biodegradation, dissolution, photolysis, and sedimentation, are planned for future incorporation.
- The Crude Oil Model simulates changes to the oil's physical and chemical properties in high-pressure environments like the deep ocean. This model also simulates changes to the oil due to degradation using a pseudo-components approach. The components may be built with detailed crude information or interpolated from more readily obtainable crude assay data.
- The Gas/Hydrates Model simulates gas properties, dissolution, and the formation and decomposition of hydrates for a variety of gases that may be present in an oil or gas well blowout.
- The Hydrodynamic Handler handles ocean data for use in the other models and is capable of providing its own correlations and interpolations from the available data. It is designed to be flexible with multiple file formats and output types.

This comprehensive suite of tools is designed to track an oil spill anywhere in the water column and follow the fate of the hydrocarbon through the water column until beaching, sinking, or complete degradation.

Activities

In 2013, BLOSOM was invited to participate in a model inter-comparison study on plume dynamics and droplet sizes, particularly in the presence of dispersants, hosted by the American Petroleum Institute (API). The API-led effort includes a wide variety of blowout modelers to determine the strengths of each model and identify areas of larger uncertainties.

BLOSOM is also being integrated into Geocube, a component of NETL's Energy Data eXchange. Geocube is a web-based mapping application that has assembled and now maintains access to current information key to evaluating subsurface energy resources in the Gulf of Mexico. Geocube's spatial data and BLOSOM's predictive modeling capability will combine to serve as a comprehensive integrated oil spill response and prevention system.

Benefits

BLOSOM complements NETL's existing UDW capabilities, enhances NETL's Geocube application, and aids in risk assessment and response planning in deepwater and ultra-deepwater conditions, ultimately helping to predict, assess, and prevent well blowouts in these challenging environments.